REMARKS

Reconsideration and allowance of the present application based on the following remarks are respectfully requested.

Drawing

The drawings are objected to as failing to comply with 37 C.F.R. § 1.84 (p)(5).

Applicants have amended the specification and added the reference to M1 and M2. Applicants submit that one of ordinary skill in the art would understand that M1 and M2 correspond to mask (reticle) alignment marks and P1 and P2 correspond to substrate alignment marks.

The drawings are objected to under 37 C.F.R. § 1.83 (a). Applicants have amended Figure 2 to include one embodiment of "a spot formation device" recited in the claim(s). Support may be found throughout the specification and, for example, in page 15 paragraph [0093] of the specification. Please see the attached Drawing Change Authorization Request to effect the changes to Figure 2. Applicants submit that no new matter has been added. Therefore, Applicants respectfully request that the objection to the drawings be withdrawn.

Specification

The reference to "sensor 14" in paragraph 83 has been changed to "sensor 16." Applicants have made a diligent effort to correct any grammatical, spelling or minor errors.

Claim Objections

Claims 16, 18-26 are objected to as being in improper form because the preamble of the claims are directed to an apparatus and the claims depend from a method claim. Claims 16, 18-22 have been amended to depend on apparatus claim 11. Claim 24 has been rewritten in independent form including all the subject matter recited in claim 11. Claim 25 has been amended to depend from claim 24. With regard to claim 26, Applicants traverse the objection to claim 26. Claim 26 is independent and is a method claim. Accordingly, Applicants respectfully submit that all the objections have been addressed and respectfully request withdrawal of the objections.

Claim Rejections – 35 USC § 112

Claims 15 and 17 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite. Claims 15 has been amended to depend on claim 12. Therefore, the "at least one pinhole" in "wherein the at least one pinhole further comprises an element to provide…scattering and diffusion of radiation," has antecedent in claim 12. The Office Action states that it is not clearly understood how the pinhole can perform the function as claimed. However, it is perfectly clear that the pinhole comprising an element inducing at least one of the diffraction, scattering and diffusion effects, provides angular distribution of radiation.

Consequently, Applicants respectfully submit that all pending claims are in full compliance with 35 U.S.C. §112.

Claim Rejection – 35 USC § 102

Claims 1-26 are rejected under 35 U.S.C. 102(b) as being allegedly anticipated by Sakai *et al.* (US Pat. 5,925,887). Applicants respectfully traverse this rejection for at least the following reasons.

With respect to claims 11-12, the Office Action contends that Sakai *et al.* discloses a projection exposure apparatus comprising all structures set forth in the claims including at least one spot formation device for forming at least one spot of radiation from at least a portion of the projection beam such as a light blocking plate 21 having a central pinhole at the substrate plane or the transmissive mask 2 defining a spot or pinhole at the mask plane; and a sensor comprising a photodiode and CCD 22 for measuring a spatial variation in intensity of defocused radiation.

Claim 11 recites, *inter-alia*, "at least one spot formation device to form at least one spot of radiation from at least a portion of said projection beam in said apparatus; and at least one radiation sensor, to measure a spatial variation in intensity of defocused radiation from the at least one spot or an image thereof."

Therefore, in the invention recited in claim 11, the radiation sensor is provided to measure variation of intensity of defocused radiation. In contrast, in Sakai *et al.* the light blocking plate 21 is set such that the surface of the blocking plate 21 is at the same level of wafer 5 surface, and it is disposed adjacent to the imaging plane of the device pattern of the reticle 2 through the projection optical system 4 (see, col. 4 lines 27-34 and Figure 1 in Sakai *et al.*). Therefore, in Sakai *et al.* the blocking plate 21 being at the same level as the wafer 5,

i.e., within the imaging plane, measures radiation which is not defocused since the projection system 4 projects, i.e. focuses, the light from the device pattern of the reticle 2 onto the wafer plane.

By using the radiation sensor recited in claim 11, properties of the performance of the projection system, such as angular dependent lens transmission can be measured. In addition, the spatial intensity distribution at a pupil of the projection system contains valuable information relating to alignment, performance and optimization of the lithographic apparatus. The spatial intensity distribution at a pupil of the projection system is, in practice, very difficult to measure in situ and sufficiently rapidly. With the use of the radiation sensor recited in claim 11, it becomes possible to measure the angular and spatial distribution of the projection system with greater accuracy and thus allowing, for example, to substantially reduce image anomalies of a projected pattern and allowing, for example, improving the accuracy of the positioning in registry of stacked layers of a device.

Consequently, Sakai *et al.* does not disclose, teach or suggest, *inter-alia*, "at least one radiation sensor, to measure a spatial variation in intensity of defocused radiation from the at least one spot or an image thereof."

Similarly, claim 1 recites, *inter-alia*, "measuring, with at least one sensor, a spatial variation in intensity of defocused radiation from the spot or from an image of the spot." Sakai *et al.* is silent about measuring spatial variation in intensity of defocused radiation. Accordingly, Sakai *et al.* does not disclose, teach or suggest the subject matter recited in claim 1.

Claim 24 contains all the limitations recited in claim 11. Therefore, Applicants submit that claim 24 is patentable for at least the reasons stated above.

Claim 26 recites, inter-alia, "measuring a spatial variation in intensity of defocused radiation from said spot..." Sakai *et al.* is silent about measuring spatial variation in intensity of defocused radiation. Accordingly, Sakai *et al.* does not disclose, teach or suggest the subject matter recited in claim 26.

Therefore, Applicants respectfully submit that claims 1, 11, 24 and 26, and claims 2-10, 12-23 and 25 which are directly or indirectly dependent from one of the claims 1, 11, 24 and 26, are patentable and respectfully request that the rejection of claims 1-26 under § 102(b) be withdrawn.

Claims 1-26 are rejected under 35 U.S.C. 102(e) as being allegedly anticipated by Irie *et al.* (US Pat. 6,118,516). Applicants respectfully traverse this rejection for at least the following reasons.

With respect to claims 1-26, the Office Action contends that Irie *et al.* discloses an exposure apparatus and method comprising all structures set forth in the claims including at least one spot formation device for forming at least one spot of radiation from at least a portion of the projection beam such as a light plate 36 having a central pinhole at the substrate plane or the transmissive mask 2 defining a spot or pinhole at the mask plane; and a sensor 48-49 for measuring a spatial variation in intensity of defocused radiation from the at least one spot or an image thereof.

Claim 11 recites, *inter-alia*, "at least one spot formation device to form at least one spot of radiation from at least a portion of said projection beam in said apparatus; and at least one radiation sensor, to measure a spatial variation in intensity of defocused radiation from the at least one spot or an image thereof."

Therefore, in the invention recited in claim 11, the radiation sensor is provided to measure variation of intensity of <u>defocused radiation</u>. In contrast, in Irie *et al.* the plate 36 is merely a reference mark plate set on the wafer stage 13 (see, Figure 4 and col. 15, lines 66-67 in Erie *et al.*) Accordingly, in Irie *et al.* the reference mark plate 36 being on the wafer stage 13, simply measures radiation which is <u>not defocused</u> because the projection system 3 (with pupil filter 4) projects, i.e. focuses, the light from the reticle 46 onto the wafer 5.

As stated above, by using the radiation sensor recited in claim 11, properties of the performance of the projection system, such as angular dependent lens transmission can be measured. In addition, the spatial intensity distribution at a pupil of the projection system contains valuable information relating to alignment, performance and optimization of the lithographic apparatus. The spatial intensity distribution at a pupil of the projection system is, in practice, very difficult to measure in situ and sufficiently rapidly. With the use of the radiation sensor recited in claim 11, it becomes possible measure to the angular and spatial distribution of the projection with greater accuracy and thus allowing, for example, to substantially reduce image anomalies of a projected pattern and allowing, for example, improving the accuracy of the positioning in registry of stacked layers of a device.

Consequently, Irie *et al.* does not disclose, teach or suggest, *inter-alia*, "at least one radiation sensor, to measure a spatial variation in intensity of defocused radiation from the at least one spot or an image thereof."

Similarly, claim 1 recites, *inter-alia*, "measuring, with at least one sensor, a spatial variation in intensity of defocused radiation from the spot or from an image of the spot." Sakai *et al.* is silent about measuring spatial variation in intensity of defocused radiation. Accordingly, Sakai *et al.* does not disclose, teach or suggest the subject matter recited in claim 1.

Claim 24 contains all the limitations recited in claim 11. Therefore, Applicants submit that claim 24 is patentable for at least the reasons stated above.

Claim 26 recites, *inter-alia*, "measuring a spatial variation in intensity of defocused radiation from said spot..." Irie *et al.* is silent about measuring spatial variation in intensity of defocused radiation. Accordingly, Irie *et al.* does not disclose, teach or suggest the subject matter recited in claim 26.

Therefore, Applicants respectfully submit that claims 1, 11, 24 and 26, and claims 2-10, 12-23 and 25 which are directly or indirectly dependent from one of the claims 1, 11, 24 and 26, are patentable and respectfully request that the rejection of claims 1-26 under § 102(e) be withdrawn.

CONCLUSION

In view of the foregoing, the claims are now believed to be in form for allowance, and such action is hereby solicited. If any point remains in issue which the Examiner feels may be best resolved through a personal or telephone interview, please contact the undersigned at the telephone number listed below.

Attached is a marked-up version of the changes made to the specification and claims by the current amendment. The attached Appendix is captioned **"Version with markings to show changes made"**.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in a condition for allowance and a Notice to that effect is earnestly solicited.

Respectfully submitted,

PILLSBURY WINTHROP LLP

By: ______________________

Robert C. Perez
Reg. No.: 39,328
Tel. No.: (703) 905-2159
Fax No.: (703) 905-2500

RCP/KG
1600 Tysons Boulevard
McLean, VA 22102
(703) 905-2000

Enclosures: Appendix
Drawing Change Authorization Request

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

[0069] a projection system ("lens") PL (e.g. a quartz and/or CaF_2 lens system or catadioptric system comprising lens elements made from such materials, or a mirror system) for imaging an irradiated portion of the mask MA onto a target portion C (e.g. comprising one or more dies) of substrate W. As shown in Figure 1, mask MA is provided with alignment marks M_1 and M_2 and substrate W is provided with alignment marks P_1 and P_2 such that the substrate W and the mask can be aligned relative to each other.

[0083] In a further variant, the spot (or object such as a mask defining a spot) can be displaced from the object focal plane at the entrance to the projection lens. For example, a quartz reticle, with a chromium pattern on one surface defining a pinhole, can be turned upside-down so that the pinhole is displaced from the focal plane along the optical axis by a distance equal to the thickness of the reticle. In this way, there is no longer a focused imagine of the spot at the wafer level, so the sensor [14] 16 can, in fact, be located at the plane corresponding to wafer level, i.e. the focal plane of the projection lens. In this variant, the sensor will be defocused with respect to a spot or image of a spot, even though the sensor is at the focal plane of the projection lens. This defocus of the sensor is a requirement common to different embodiments of the present invention.

IN THE CLAIMS:

12. (Amended) An apparatus according to claim [10] 11, wherein said at least one spot formation device comprises at least one pinhole located at one of the mask plane and the substrate plane.

30341603 1.DOC

13. (Amended) An apparatus according to claim [11] 12, wherein the at least one pinhole further comprises subsidiary dots, of size substantially equal to a wavelength of the radiation.

14. (Amended) An apparatus according to claim [11] 12, wherein the at least one pinhole further comprises a diffraction grating.

15. (Amended) An apparatus according to claim [11] 12, wherein the at least one pinhole further comprises an element to provide an angular distribution of radiation using at least one radiation manipulation effect selected from the group of radiation manipulation effects [comprising] including diffraction, scattering and diffusion of radiation.

16. (Amended) An apparatus according to claim [10] 11, wherein, in use, the at least one sensor is defocused by a distance greater than a size of the respective spot.

18. (Amended) An apparatus according to claim [10] 11, wherein the at least one sensor comprises a photodiode with small detection area.

19. (Amended) An apparatus according to claim [10] 11, wherein the at least one sensor comprises a charge-coupled device (CCD).

20. (Amended) An apparatus according to claim [10] 11, wherein the at least one sensor further comprises a lens.

21. (Amended) An apparatus according to claim [10] 11, wherein the at least one sensor is moveable so as to perform a scan of the radiation emanating from the spot.

22. (Amended) An apparatus according to claim [10] 11, further comprising a calculation unit for determining properties of the apparatus from the measurements taken by the at least one sensor.

23. (Amended) An apparatus according to claim 21, further comprising actuators [for] constructed and arranged to [adjusting] adjust said apparatus to at least partially compensate

for deviation from optimal of any of the determined properties based on signals from said calculating unit.

24. (Amended) A method of manufacturing a device [comprising] including operating a lithographic projection apparatus [as defined in claim [10]] comprising:

a radiation system, to provide a projection beam of radiation;

a first object table to hold a mask at a mask plane;

a second object table to hold a substrate at a substrate plane;

a projection system to image irradiated portions of the mask onto target portions of the substrate;

at least one spot formation device to form at least one spot of radiation from at least a portion of said projection beam in said apparatus; and

at least one radiation sensor, to measure a spatial variation in intensity of defocused radiation from the at least one spot or an image thereof.

25. (Amended) A device manufactured according to the method of claim [23] 24.

IN THE ABSTRACT OF THE DISCLOSURE:

The abstract is changed as follows:

[METHOD OF OPERATING A LITHOGRAPHIC APPARATUS, LITHOGRAPHIC APPARATUS, METHOD OF MANUFACTURING A DEVICE, AND DEVICE MANUFACTURED THEREBY]

A method of operating a lithographic projection apparatus [comprises] including forming a spot of radiation at the wafer level using a pinhole at reticle level. A sensor is defocused with respect to [said] the spot such that it is spaced apart from [said] the wafer level. The sensor is scanned beneath the spot to measure the angular intensity distribution of radiation at the spot and to determine the intensity distribution at the pupil plane of the projection lens system.

End of Appendix